

What is claimed is:

1. A discharge lamp lighting device comprising:
  - a rectifier for rectifying an AC power source;
  - 5 a DC power source circuit including at least one smoothing capacitor and connected to an output terminal of the rectifier;
  - 10 an inverter circuit, which includes two switching elements coupled in series to each other and is connected to an output terminal of the DC power source circuit, for turning the switching elements on and off alternately;
  - 15 a load circuit, which includes at least one resonance inductor, one resonance capacitor and one discharge lamp, for lighting the discharge lamp by a resonance generated by using a high frequency voltage inputted from the inverter circuit;
  - 20 a control IC for controlling operations of the switching elements of the inverter circuit; and
  - a control power source circuit for supplying a control power to the control IC,
- wherein the control IC includes:
  - 25 a first timer unit for determining a status conversion timing for performing a shift from a preheating status, where the discharge lamp is preheated, to an ignition status, where an ignition voltage is applied to the discharge lamp, and finally to a lighting status, where the discharge lamp

is lighted with a predetermined output power;

5 a first control unit for determining an on/off timing of the switching elements of the inverter circuit based on a control signal provided from the first timer unit and outputting a driving signal to the switching elements of the inverter circuit;

10 a second control unit for controlling variations in the cycle of the driving signal and generation of the driving signal provided from the first control unit based on a control signal inputted from an exterior of the control IC to perform a dimming control of the discharge lamp or a control of the inverter circuit;

15 an operation status output unit for outputting a predetermined status signal corresponding to an operational status of the IC control circuit; and

an operation setting circuit for inputting the status signal provided from the operation status output unit and outputting a control signal to the second control unit,

20 wherein the operation status output unit outputs a status signal corresponding to at least the lighting status.

2. The device of claim 1, wherein the operation status output unit of the control IC outputs status signals corresponding to at least two among the preheating status, 25 the ignition status, the lighting status and a status where the second control unit is operating.

3. The device of claim 2, wherein the control IC includes a driving unit, which is connected to an output terminal of the rectifier or the DC power source circuit, for supplying 5 a control power from the control power source when the operation of the inverter circuit is stopped and the operation status output unit outputs a status signal corresponding to a status in which the driving unit operates to supply the control power source.

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4. The device of any one of claims 1 to 3, further comprising a no-load detecting circuit for detecting whether or not the discharge lamp is connected to the lighting device, wherein the control IC includes:

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a first abnormality determination unit for determining an occurrence of an abnormal status based on a detection signal inputted from the no-load detecting circuit; and

a first output suppression unit for stopping an operation of the inverter circuit when the abnormal status

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is detected,

wherein the operation status output unit outputs a status signal corresponding to a first output suppression status in which the first output suppression unit is operating.

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5. The device of claim 1, further comprising a lamp

lifetime detection circuit for detecting the remaining lifetime of the discharge lamp, wherein the control IC includes:

5 a second abnormality determination unit for determining an occurrence of an abnormal status based on a detection signal inputted from the lamp lifetime detection circuit; and

10 a second output suppression unit for restraining or stopping generation of an output of the inverter circuit when the abnormal state is detected,

15 wherein an operation of at least one of the second abnormality determination unit and the second output suppression unit is stopped during a time period from an initial status of the first timer unit to a status conversion stage in which the initial status of the first timer unit is ended, and the operation status output unit outputs a status signal corresponding to a second output suppression status in which the second output suppression unit is operating.

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6. The device of claim 5, wherein the control IC further includes:

25 a second timer unit for determining an output suppression period during which the second output suppression unit is operating; and

a suspension maintenance unit for maintaining a

suspension of an operation of the inverter circuit in case a count number of operations of the second output suppression unit reaches a predetermined value when the second output suppression status is terminated after the output suppression period has elapsed and an operation of the first timer unit is initiated from the initial status thereof.

wherein the operation status output unit outputs a status signal corresponding to the second suppression status in which the second suppression unit is operating and a status signal corresponding to a suspension status in which the suspension maintenance unit is operating.

7. The device of claim 1, further comprising a low voltage detection circuit for detecting a decrease of a supply voltage provided from the AC power source, wherein the control IC includes:

a third abnormality determination unit for determining an occurrence of an abnormal status based on a detection signal inputted from the low voltage detection circuit; and

wherein the operation status output unit outputs a status signal corresponding to a third output suppression status in which the third output suppression unit is operating.

8. The device of claim 1, further comprising a smoothed output detection circuit for detecting an output voltage of the DC power source circuit, wherein the DC power source circuit includes at least one switching element and the control IC further includes:

5 a differential amplifier for comparing a detection signal inputted from the smoothed output detection circuit with a predetermined reference value;

10 a third control unit for controlling an on/off timing of the switching elements of the DC power source circuit based on an output signal from the differential amplifier and outputting a driving signal to the switching elements of the DC power source circuit;

15 a fourth abnormality determination unit for determining an occurrence of an abnormal status based on the detection signal inputted from the smoothed output detection circuit; and

20 a fourth output suppression unit for stopping an output of the driving signal to the switching elements of the DC power source circuit or restraining generation of an output of the inverter circuit when the abnormal status is detected,

25 wherein the operation status output unit outputs a status signal corresponding to a fourth output suppression status in which the fourth output suppression unit is

operating.

9. The device of claim 1, wherein a status signal outputted from the operation status output unit is a DC 5 voltage signal corresponding to at least one of the three operational statuses of the control IC.

10. The device of claim 1, wherein a status signal outputted from the operation status output unit is a duty 10 signal corresponding to at least one of the three operational statuses of the control IC.

11. The device of claim 1, wherein a status signal outputted from the operation status output unit includes a 15 duty signal and a DC voltage signal.

12. The device of any one of claims 5 to 11, wherein the status signals at least corresponding to the first output suppression status, the third output suppression status and 20 the fourth output status are the same.

13. The device of claim 6, wherein a status signal generated during a predetermined time period immediately after entering into the first output suppression status is 25 identical to the status signal corresponding to the second output suppression status or the suspension status, and a

status signal outputted after an elapse of the predetermined time period is different from the status signal corresponding to the second output suppression status or the suspension status.

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14. The device of claim 1, wherein the control IC further includes a reference voltage generator, and a voltage outputted to the exterior of the control IC from the reference voltage generator is inputted to the operation setting unit after entering the preheating status.

15. The device of claim 14, wherein the voltage outputted to the exterior of the control IC from the reference voltage generator is supplied as a control source power for the operation setting circuit.

16. The device of claim 6, wherein the first and the second timer unit determine a status conversion timing and an output suppression period by counting the number of reference clock signals inputted thereto, each having a certain frequency, and the reference clock signals are generated by the operation setting circuit and the frequency thereof is varied depending on the status signals.

25 17. The device of claim 5, wherein the operation setting unit includes:

an A/D converter for converting a status signal to a digital signal, the status signal being inputted from the operation setting circuit;

5 a time counter for measuring an accumulated time in accordance with the status signal of the control IC indicating at least the lighting status;

a storage unit for storing the accumulated time;

10 an operation correction unit for outputting a control signal in accordance with the accumulated time stored in the storage unit to the second control unit of the control IC;

a reset unit for initializing the accumulated time stored in the storage unit in accordance with the status signal corresponding to the second output suppression state or the suspension state; and

15 a conversion-to-sleep state unit for stopping an operation of the operation setting unit in accordance with the status signal corresponding to the first output suppression status.

20 18. A lighting apparatus comprising the discharge lighting device described in any one of claims 1 to 3.